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(54) IMPROVEMENTS IN OR RELATING TO DRIVING ELECTRIC MICRO-MOTORS FOR ELECTRONIC TIMEPIECES

(71) We, KABUSHIKI KAISHA DAINI SEIKOSHA- a Japanese Company of 31—1, Kameido 6-chome, Koto-ku, Tokyo, Japan, do hereby declare the invention, for which we pray that a patent may be granted to us, and the method by which it is to be performed, to be particularly described in and by the following statement:—

This invention relates to driving electric micro-motors (i.e. very small motors) for electronic timepieces and especially electronic watches.

Figure 1 of the accompanying drawings shows a driving electric micro motor as commonly used in electronic watches at the present time. It has a straight wound core C. Since the periphery of the case M of a watch movement is nearly always curved, the straight core leaves a narrow segmental space (segmental, assuming a circular watch case) between the straight core C and the case. This represents a waste of space which can be ill afforded, for owing to its size and shape, it is almost impossible to make use of it. Also because the space available for housing the motor in the movement case is severely limited, the wasteful utilisation by a straight cored motor, of the space which is available makes it difficult for the motor designer to design a motor of good performance.

The present invention seeks to overcome the above defects and to provide for an electronic timepiece a micro-motor which can be accommodated with minimum waste of space in the movement case of a watch or other timepiece and which shall be such as to enable a good performance micro motor to be provided in a relatively small watch or other timepiece.

According to this invention an electric micro-motor suitable for use as a driving motor in an electronic timepiece comprises a curved wound core with stator pole pieces attached to its ends and extending towards one another inwardly from said ends, said pole pieces being adjacent to said core over their lengths and having between their inner ends a rotor mounted for rotation in the air gap between the said inner ends.

The curvature is preferably that of an arc.

The core may have, adjacent to the pole pieces, flanged ends which may be parallel to one another or normal to the line of curvature.

The core curvature may be either concave or convex as viewed from the axis of rotation of the rotor.

The invention also provides improved electronic timepieces. Such a timepiece, in accordance with this invention, includes a movement case with a curved periphery or wall and, mounted within said case, a motor which is in accordance with the invention and is mounted within said case with its rotor arranged to drive a timepiece movement which is also within said case, said motor being mounted within said case with its core between the motor rotor and the said curved periphery or wall. If the core curvature is concave as viewed from the axis of rotor rotation it may have a curvature corresponding with that of the movement case, the motor being mounted in said case with said core lying close against the curved wall of said movement case. If the core curvature is convex as viewed from the axis of rotor rotation, the motor may be mounted within the movement case so that the case wall curvature and the core curvature are concave with respect to one another, the case wall and the core providing between them an approximately lentil shaped space.

The invention is illustrated in Figures 2 and 3 of the accompanying drawings in which:

Figure 2 shows one embodiment of the invention in plan view,

Figure 3 is a plan view of another embodiment of the invention, and

Figures 4 and 5 show respectively further embodiments of the invention.

Referring to Figure 2 the case 1 of the movement of an electronic watch has a curved wall or periphery 1a. As shown the curvature is circular. The driving motor has a core 3 on which is wound a coil winding 2 which is constructed by winding the coil on the core 3 as indicated by the direction of arrow "A". The core 3 is curved in accordance with the wall of the movement case 1, so that, when the motor is mounted in the position shown, there is practically no space between the wall 1a and the core 3. The flanged portions 2a and 2b of the core 3 are parallel to each other and to the winding direction "A" of the coil 2. Therefore since the winding direction is similar to that of the winding on a straight core the winding operation is easy and the wound core shape is the same on its inner side and on its outer side.

6 and 6a are screws for holding the core member 3 and stator pole pieces 5 together; 7 is the motor rotor which is rotatably mounted in the pole piece gap; 8 and 8a are eccentric pins for adjustment of the air gap between the pole pieces 5 and the rotor 7; 9 and 9a are the mounting screws for the pole pieces 5; and 10 is a gear wheel of the movement meshing with a pinion on the rotor shaft.

Referring now to Figure 3, 1a is again the curved periphery of movement case 1 and 3 is the curved core which carries the coil winding 2 constructed by winding in direction "A". Again the core 3 is curved to accord with the periphery 1a of the movement case 1, so that again when the motor is mounted as shown, there is practically no space between the wound core and the said periphery 1a.

In Figure 3 the flange portions 2a and 2b of the core 3, and the winding direction "A" of the coil are normal to (i.e. radial with respect to) the circularly curved watch case wall 1a. Winding the coil presents no difficulties, the coil shape is a good one and the magnetic field path in the motor is such as to give excellent efficiency from the magnetic viewpoint.

6 and 6a are screws for holding the core member 3 to the stator pole pieces 5; 7 is the rotor; 8 and 8a are eccentric pins for adjustment of the air gap between the stator pole pieces 5 and the rotor 7; 9 and 9a are mounting screws for the stator pole pieces 5; and 10 is a movement gear wheel meshing with a pinion on the shaft of the rotor 7.

Since the wound core 3 is curved to accord with the periphery of the movement case 1, the available space is very effectively utilized when the motor is in the position shown.

Referring now to Figures 4 and 5, in both these figures the curved wall of the movement case 1 is referenced 1a, and 3 is the core which is wound with a winding 2. In each of these figures arrow A indicates the winding direction. In both figures the core is again curved but the curvature is convex (as viewed from the rotor shaft instead of being concave as in Figures 2 and 3. Accordingly a substantial space 4, large enough and of such shape as to be practically utilisable to advantage (as the space SP in Figure 1 is not), is left between the core 3 and the wall 1a.

In the embodiment of Figure 4 the flange portions 2a and 2b of the core 3 are parallel to each other and to the winding direction "A" so that winding presents no difficulties and the wound coil shape has the same curvature on its inner and outer sides. In the embodiment of Figure 5 the end flanges 2a and 2b of the core 3 and the winding direction are normal to the curvature (i.e. radial with respect to the curvature) of the core 3, so that again the winding operation is easy and coil shape is a good one from the viewpoint of maintaining its shape, and the core and stator pole pieces provide a magnetic circuit which is very efficient magnetically.

6 and 6a are screws for holding the core 3 and the stator pole pieces 5 together; 7 is the rotor which is rotatably mounted in the gap between the pole pieces 5; 8 and 8a are eccentric pins for adjusting the air gap between the stator pole pieces 5 and the rotor 7; and 9 and 9a are mounting screws for the stator pole pieces 5. In both Figures 4 and 5 practical utilisation of the space 4 is shown, 11 represents electrical elements, e.g. condenser, which are required in the watch, mounted in the spaces 4.

As will at once be apparent from a comparison of the shape and size of the space 4 of Figures 4 and 5 with the space SP of Figure 1, the space 4 is of practical use whereas the space SP is mere waste space. The advantages of the embodiments shown in Figures 4 and 5 over the usual known arrangement shown in Figure 1 are especially significant in the case of watches in which the movement which has to be accommodated is a relatively large one.

In Figure 5, in which the flange portions 2a and 2b of the core 3 are not parallel to one another but are radial with respect to the arc of curvature, the shape and size of the space 4 make it particularly convenient for utilisation. This is indicated in Figure 5 by showing two electrical elements 11 (e.g. condensers) in space 4.

WHAT WE CLAIM IS:—

1. An electric micro-motor suitable for use as a driving motor in an electronic timepiece, said motor comprising a curved wound core with stator pole pieces attached to its ends and extending towards one another inwardly from said ends, said pole pieces being adjacent to said core over their lengths and having between their inner ends a rotor mounted for rotation in the air gap between the said inner ends.

2. A motor as claimed in claim 1 wherein the curvature is that of an arc.

3. A motor as claimed in claim 1 or 2 wherein the core has, adjacent to the pole pieces, flanged ends which are parallel to one another.

4. A motor as claimed in claim 1 or 2 wherein the core has, adjacent to the pole pieces, flanged ends which are normal to the line of curvature.

5. A motor as claimed in any of the preceding claims 1 to 4 wherein the core curvature is concave as viewed from the axis of rotation of the rotor.

6. A motor as claimed in any of the preceding claims 1 to 4 wherein the core curvature is convex as viewed from the axis of rotation of the rotor.

7. An electronic timepiece having a movement case with a curved periphery or wall, and a driving electric motor as claimed in any of the preceding claims mounted within said case and with its rotor arranged to drive a timepiece movement which is also within said case, said motor being mounted within said case with its core between the motor rotor and the said curved periphery or wall.

8. A timepiece as claimed in claim 7 wherein the motor is as claimed in claim 5 or in claim 5 and any of claims 2, 3 or 4 and has a core the curvature of which corresponds with that of the movement case, the motor being mounted in said case with said core lying close against the curved wall of the said movement case.

9. A timepiece as claimed in claim 7 wherein the motor is as claimed in claim 6 or in claim 6 and any of claims 2, 3 and 4 wherein the motor is mounted within the movement case so that the case wall curvature and the core curvature are concave with respect to one another, the case wall and the core providing between them an approximately lentil shaped space.

10. Electric micro motors suitable for use as driving motors in electronic timepieces and substantially as illustrated in Figures 2 to 5 inclusive of the accompanying drawings.

11. An electronic timepiece having a driving motor as claimed in claim 10.

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Sheet 2

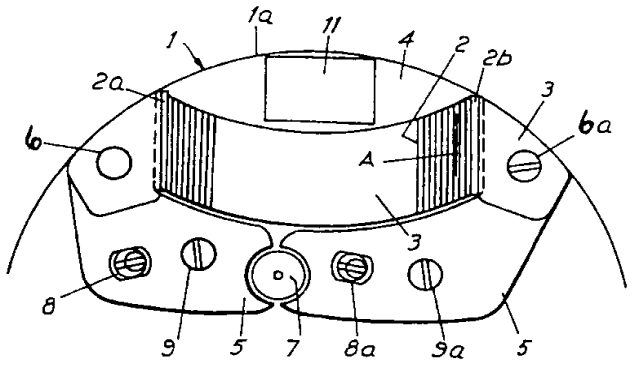

Fig. 4

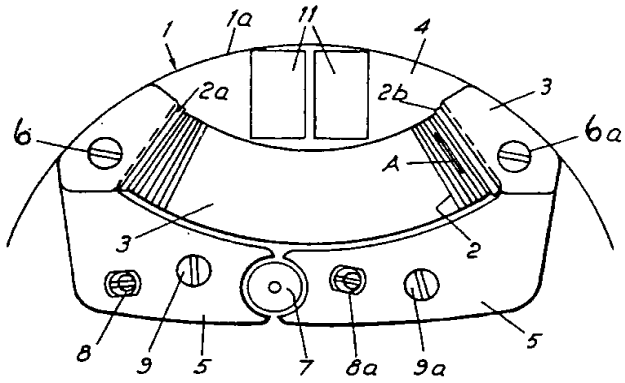

Fig. 5

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2 SHEETS *This drawing is a reproduction of the Original on a reduced scale*

Sheet 1

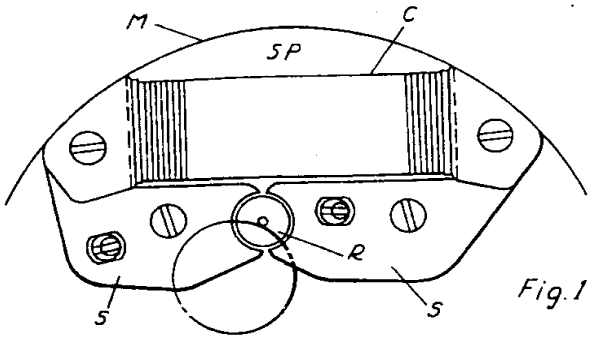

Fig. 1

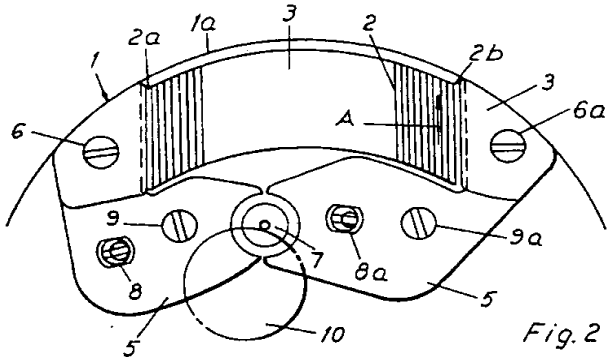

Fig. 2

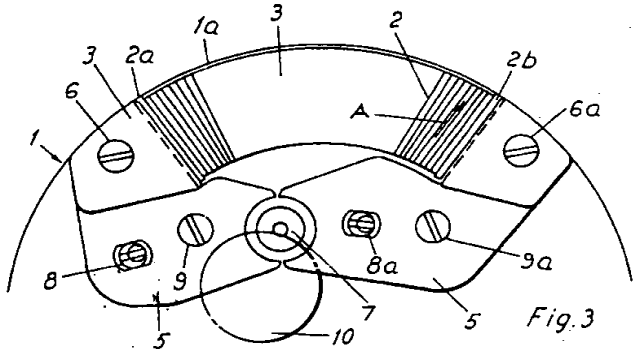

Fig. 3